Journal of Chemical Education

Published by
Division of Chemical Education of The American Chemical Society
Easton, Pa.

Entered as Second-class Matter, January 31, 1924, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized January 31, 1924.

Vol. I **December, 1924** **No. 10**

EDITORS' OUTLOOK

With this issue we bid farewell to the first year of the JOURNAL OF CHEMICAL EDUCATION, and hail the approaching year with high anticipation. The great response received during 1924 from CHEMICAL EDUCATION inspires us to put forth our best efforts for 1925. THIS JOURNAL has seemed to meet a need in both this country and abroad. Some may be interested to read a sample of the foreign letters sent in response to the International editorial written in the September issue.

Zierikzee, Holland,
October 9, 1924.

Prof. Neil E. Gordon, Editor of *The Journal of Chemical Education*,
University of Maryland, U. S. A.

Dear Sir:

Some few days ago I received the September issue of the *Journal of Chemical Education* and I must say that I like it very much. It is just the sort of thing I am seeking as chairman of the section of teachers in the Dutch Chemical Society. You will oblige me very much by sending me the numbers which have appeared up to this time and noting me as a subscriber. My bookseller who sends you this letter will be our medium in this respect. We are interested in the manner in which American teachers try to improve their methods and the ideals concerning chemical education in your country.

It will be considered as an honor when you will publish an account of the principles and accomplishments of chemical education in Holland. When you want to publish something about that please be so kind as to let me know and I'll send you from time to time noteworthy news from your fellow-workers in this country.

After having received your answer I'll direct the attention of the members of the Society to the new periodical.

If you wish to publish anything in this letter I give you free leave.

Respectfully yours,
IR. H. A. PIETERS, Chairman of the Section of Teachers, Members of the Dutch Chemical Society.

At the Ithaca meeting the editors decided to make THIS JOURNAL international in the sense of publishing foreign articles. France happens to be the first foreign country to favor us. A paper, entitled "Chemistry in the French Lycees," will appear in the January issue.

The importance of history in chemical education warrants us organizing a new department in THIS JOURNAL for 1925 known as Historical Chemistry. This department will be headed by Dr. Lyman C. Newell who has made this field a life study and who has a wealth of material from which to draw. Dr. Edgar F. Smith, Leader of Historical Chemistry in America, has consented to write the first series of articles, and it is hoped that this series may begin with the January issue.

So much interest is being shown in the National Prize Essay Contest of the A. C. S. that it has been decided to make a special feature of this in the January number. This issue will include a report of the National Prize Essay Committee of which Dr. H. E. Howe is chairman, and also the six national winning essays for 1924.

The January number will begin to feature a "Digest on Chemical Education." It is expected that there will be a series of abstracts in each issue, bringing to the attention of the teacher some of the research which is most applicable in their teaching.

All readers will be interested to know that the first year's success of THIS JOURNAL warrants its enlargement for the coming year without any increase in subscription price.

THE POSITION OF THE METALS IN THE INTRODUCTORY COURSE

R. A. BAKER, SYRACUSE UNIVERSITY, SYRACUSE, N. Y.

In the introductory course in chemistry in both high school and college it seems to be common practice to study the non-metals before considering the metals—except as the latter may be drawn upon for illustration. This statement results from a survey of the textbooks of general chemistry and is based upon the assumption that the order of the text is followed when used by a class.

There have, however, been exceptions to this general practice. Attfield[1] develops the fundamental properties of both metals and non-metals before proceeding to the non-metallic groups. Richter[2] first emphasizes the classification of the elements into metals and non-metals, while the body of his text follows the periodic system. Ramsay[3] and Venable[4] also arrange the material according to the periodic system. Hinrichs,[5] before proceeding with the non-metals first discusses metals, alloys, amalgams and ores. Oldberg[6] very early in his text lays particular stress on distinctions between the metals and non-metals and the general properties of both. Hill[7] introduces the physical and chemical properties of the metals before turning to the non-metals, but the method is encyclopedic and his text lacks continuity. Bradbury[8] follows the order: sulfur—metals—metal sulfides—native metals—carbon—oxygen—oxides of metals, etc. Gray, Sandifur and Hanna,[9] in the most recent text which has come to my notice, begin the course with the metals, their oxides and hydroxides. Howe[10] suggests that "the metals make the simplest starting point" in the study of science. Segerblom[11] says, "It has always seemed to me more logical to start, not with the gases, but with some solids such as metals." He reports having used the modified order with marked success.

I am one of those who believe that an introduction to chemistry via the hydrogen-oxygen-water route is not wholly satisfactory. Although of

[1] Attfield, "Chemistry, General, Medicinal and Pharmaceutical," 1st ed., **1867**; 14th ed., **1894.**

[2] Richter (trans. by Smith), "Textbook of Inorganic Chemistry," 1st ed., **1883**; 5th ed., **1900.**

[3] Sir Wm. Ramsay, "A System of Inorganic Chemistry," **1891.**

[4] Venable and Howe, "Inorganic Chemistry According to the Periodic Law," **1898.**

[5] Hinrichs, "Introduction to General Chemistry," **1897.**

[6] Oldberg, "Inorganic Chemistry, General, Medical and Pharmaceutical," **1900.**

[7] Hill, "Textbook of Chemistry," **1903.**

[8] Bradbury, "An Inductive Chemistry," **1912.** In his preface Bradbury gives credit for the modified order to Ohmann (referring presumably to Ohmann's "Die Verhüttung von Unfallen in chemischen und physikalischen Unterricht.")

[9] Gray, Sandifur and Hanna, "Fundamentals of Chemistry," **1924.**

[10] Howe, "Systematic Science Teaching," **1894.**

[11] *Science*, **56**, 320 (1922). Segerblom, "A First Course in Chemistry."

the utmost importance hydrogen and oxygen share the disadvantages of being invisible, odorless, tasteless and rather inert under ordinary conditions. Hence they present no real picture to a majority of the uninitiated.

It seems logical to begin the chemistry course with tangible substances, preferably elements, which are already familiar to the student. The metals fill all these requirements. Most people are acquainted with some twelve elements: aluminum, carbon, copper, gold, iron, lead, mercury, nickel, silver, sulfur, tin and zinc. All but two of these are metals. The popular terms "metal" and "metallic" are fairly acceptable. Associated with familiar metals are certain common properties such as luster, malleability and conductivity. The average person has observed the use of copper and iron as conductors of electricity in ordinary lighting and power circuits. Their malleability and ductility are attested by the variety of metal sheets and wires which he has either used or seen: aluminum iron zinc and lead sheet, tin and aluminum foils, gold and aluminum leaf, iron and copper wire, etc. Similarly the use of metals for weights, coins, jewelry, protective coatings, type, etc., may be shown to be intimately associated with some property of the metal in question.

For the past ten years I have followed the plan of introducing the metals first in the elementary course. While this has involved the necessity of writing a laboratory manual and a syllabus for recitations and textbook assignments, nevertheless the results have amply justified the effort. The following order of presentation of material has gradually evolved:

The first step is to correlate the knowledge of the metals already possessed by the average student. The list is expanded "painlessly" to include all those which are to receive attention during the year. Their names and symbols are memorized at this time.[1] The next step is to distinguish the metals from the "non-metals," emphasizing the fact that the former constitute an "orderly" group of elements, which have characteristic physical properties and which differ markedly from the non-metals in their chemical and particularly their electrochemical behavior. The properties emphasized at this point may be grouped as follows:

A. Physical.
   1. All metals are opaque and have metallic luster.
   2. They are more malleable and ductile than the non-metals.
   3. They are better conductors of heat and electricity than the non-metals.
   4. They are all very nearly the color of silver—except copper and gold.
   5. Most of the metals and their compounds are solids at ordinary temperatures.

[1] Students are required to learn some 22 metals in the order of the Electrochemical Series. The value of this practice will be the subject of a succeeding paper.

B. Chemical.

1. In accordance with the general principle that the more unlike substances are the greater the attraction between them,
   (*a*) Metals do not combine readily with each other.
   (*b*) Metals combine readily with the non-metals.
   (*c*) It is possible to arrange the metals in a series which fairly represents their combining potentials.
2. The metals are constituents of most bases and salts.

Before proceeding beyond this point the idea of specific properties is developed. Then oxygen is introduced, followed by metal oxides, hydrogen, water, metal hydroxides, bases, salts, nitrogen, sulfur, halogens, carbon, phosphorus, silicon and boron. While the order of arrangement of the conventional text is not seriously disturbed, a most important feature is that whenever a non-metal is introduced its chemistry is projected upon the "screen" furnished by the whole group of metals. Thus all sulfates are studied together—similarly all nitrates and all carbonates. To be more specific, under carbonic acid the following topics are developed: relative solubilities of metal carbonates and bicarbonates, effect of heat on each, transportation of calcium and magnesium by surface waters, the manufacture of soda, lime, white lead, etc. By studying as a group all the metal derivatives of a non-metallic radical the student gains a perspective which is impossible when the same facts are studied piecemeal under sodium, calcium or lead.

The average student finds great satisfaction in relabelling as "chemistry" his knowledge of metals. It stimulates his interest to know that these substances are chemical elements and that they are to serve as the foundation of the course.

Chemistry has such a reputation for being hard that many students are needlessly worried. By placing the metals first such students can cling to these old chemical friends while they gain a measure of confidence. This confidence should be capitalized largely before the student is exposed to the barrage of symbols, formulas, nomenclature, valence, chemical arithmetic and such other offensive projectiles in this species of chemical warfare known as the Introductory Course.

The meaning of "specific property" is easily developed with the metals. The student already knows that tin melts before gold; that lead is heavier than aluminum; that copper is harder than lead and that iron rusts more readily than nickel. He is interested to find that no two substances have identical properties, but rather that each has a personality all its own. When he sees that substances, like people, respond to their environment, such "responses" as melting points and boiling points are no longer abstract.

Metals are comparatively uniform in their chemistry. The greater number do not have multiple valence; they are monatomic and they do not

exhibit allotropism to the same extent as the non-metals. Simple experiments can be devised to illustrate practically all the important principles with the exception of the gas laws. In some cases, because the metals are tangible, these experiments have a tremendously greater value than the usual experiments with gaseous non-metals.

For those who advocate the historical method[1] of studying chemistry an appropriate slogan would be, "Say It with Metals." Both before and since chemistry was recognized as a distinct branch of science, advance in civilization has gone hand in hand with knowledge of the metals.

The relative activities of iron, tin and copper decreed that the bronze age should precede the iron age; chance production of alloys having the color of gold probably led to belief in transmutation and gave us Alchemy; an unfortunate explosion in the laboratory of Boyle indirectly caused him to misinterpret the fact that tin increased in weight when heated in air, and paved the way for the Phlogiston Theory. Priestley heated a metallic oxide to produce pure oxygen; Dulong and Petit laid a metal foundation for the Law of Specific Heats while quantitative chemistry was ushered in through metal doors by Proust and Stas.

From the time when Lavoisier demonstrated that the metals are simple substances until the present, when the spontaneous disintegration of metal atoms, the emission of electrons from hot metal surfaces and the X-ray spectra of metal crystals are demanding attention, faithful records of research furnish the student with outstanding examples of the application of the scientific method.

SHOULD TEACHERS DO RESEARCH OR COMMERCIAL WORK?*

C. C. HEDGES, A & M COLLEGE OF TEXAS, COLLEGE STATION, TEXAS.

The discussion of the subject "Should Teachers do Research Work or Commercial Work" quite naturally divides itself into two divisions. First, should teachers be research men actually engaged in the work? And second, should teachers be allowed to practice the profession while teaching?

Teachers, research men, and executives should be selected for the respective places according to their ability, teachers to lead the student in an enthusiastic path of study, research men to solve the mystery of the research problems, and executives to guide the organization through troubled waters. A teacher is not necessarily a good research man and a good research man does not generally make a good teacher. The mind required

[1] Holmyard, "The Historical Method in the Teaching of Chemistry," *School Science Review*, **5**, 227 (1924).

* Read in the Division of Chemical Education of the American Chemical Society, at the Washington meeting, April 24, 1924.

for an investigator is not the same as that required to make a good instructor. A teacher does not necessarily need to do research work in order to present the latest developments in his line of teaching, provided he is allowed spare time and uses this spare time in studying publications giving the latest investigations. He can obtain a better knowledge of the latest development in research work in this way than by confining his study to one or two individual problems in connection with part time research work. He will make a better teacher than the man who does teaching half time and research work the other half. The man with the divided duty will have the problems of the teacher to combat as well as research problems, thus preventing any concentration of energy in one line.

Anyone who has worked on a piece of research knows that it is necessary for him to have his mind on that problem night and day if he expects to get to the bottom of the work. It cannot be discarded when he leaves the laboratory for the day, as many a problem has been solved during dreams. It must be a part of himself and any man who has several irons in the fire such as teaching, directing of graduate work, personal research work, or private consultations cannot concentrate his mind sufficiently to be the most efficient in any one line. This is the day of specialization. In our industries we have our specialists in every line of endeavor. No one man tries to cover the whole industrial field. So it should be in the colleges. We should have teachers who specialize in teaching and research men who specialize for investigational work. You cannot serve two masters. If a man enters the teaching profession he should devote his entire time to the problems in connection with this teaching. These problems are numerous if the individual will look for them. Colleges and Universities should pay large enough salaries so it will not be necessary for the teacher to depend upon any other source of income in order to be contented with his work.

Theoretically, it is a beautiful arrangement for teachers to do part time research work or consultation work but practically it is not efficient. This arrangement where experiment station men devote part of their time to teaching has been found in many colleges to be a failure due to the fact that either the teaching was neglected or the Experiment Station work, depending altogether in which field the individual was most interested. I have seen the work of a good research man spoiled by dividing his time with teaching or by being placed in an executive position. A man doing research work should not have his mind taken from his line of investigation for even a short time. Each department should have research men, separate from their teaching staff, picked for their ability to do research work in the problems connected with the departmental work and to direct undergraduate and graduate research keeping close contact with the teaching staff by departmental conferences.

It is common at the present time for teachers, especially of engineering

to accept commercial work or employment in the general practice of their profession. It is not uncommon for those in charge of engineering colleges to suggest, as an inducement in obtaining the services of more experienced men as teachers, that an opportunity would be given them to do outside work. Cases are not rare where the income obtained from consultation work exceeds the salary they obtain as teachers. This practice does not prove that this opportunity for teachers to do consultation work should or should not be allowed. It only shows that it is permissible or necessary under the low salary condition, in order to obtain competent teachers of engineering subjects. This condition opens the door for the teacher to abuse the privilege granted him and makes it necessary for us to pause a moment to consider if it is wise to allow teachers to engage in contemporaneous practice.

It is generally conceded that it is necessary for teachers of engineering subjects to have had some practical experience in order to be very efficient teachers. Many colleges before making appointments to their staff require the applicants to have had from two to four years of practical experience. It is understood that this practical experience is necessary for the teacher to have illustrations to give to his classes with the viewpoint of the man in the practical field. If we acknowledge that the above condition is necessary, then it naturally remains for us to determine the best method to obtain such trained men. In other words, is it desirable or plausible for colleges to make practical experience a requirement before men are appointed to the teaching staff, allowing the more experienced men the opportunity to do consultation work in connection with their teaching. Would it not be better to obtain the best theoretically trained men possible, make a teaching schedule of nine months a year for every man and require them to do practical work during the summer? Is it the man with practical experience that makes the best teacher? Does he not have the tendency to ignore the details of the study and get at the problems by the closest cut? I realize that the man without practical experience has a tendency to emphasize the details too much. Which is the greater of the two evils? For these reasons we train men in exact methods of analysis of the laboratory instead of commercial methods. He can grasp commercial methods readily after having a training in exactness but he can never become a research man where exactness is required, if he is first trained in industrial methods.

After a man spends from two to four years in practical work it will be impossible for the college to obtain at the salary offered the most successful men in the profession. The college will be forced to accept from the practical field the less successful men, even though an opportunity be offered them to do outside work, for the income from such a source would be very small especially for men with limited practical experience and reputation

in engineering work. Colleges so isolated that their teachers are not available for consultation work must pay higher salaries to their teaching staff if they expect to obtain the same efficiency. It is therefore evident that high salaries must be paid by the colleges to attract good men with small amount of practical experience and in order to attract men with national reputation and broad experience in the engineering profession it is absolutely necessary that consultation work be allowed in connection with their teaching duties or very much higher salaries must be paid, especially in institutions located at a disadvantage. Would it not be better for colleges to offer salaries large enough to attract good men with practical experience without compromising the college and the student by offering the prospective teacher an opportunity to do outside work in connection with his teaching duties? I realize the argument advanced against this arrangement is that the student is greatly benefited by the contact with such a person doing consultation work although the teacher may be absent from his classes one-third of the time. I think this argument is generally overdrawn in many cases for convenience.

It is natural to ask the question; Is it very necessary for teachers of engineering to know the very latest practice in every line of engineering which they can use when they get into actual practice? Can the teacher of engineering obtain the latest practice in the field of engineering by the limited amount and restricted field of practice he would be allowed to do in connection with his duties in the college or would he become better posted by devoting his extra time to the study of the latest engineering publications and devoting his summer to practical work, or doing research in the engineering experiment station?

I have seen men so absorbed in their outside practice that the student was only a minor thought. I have seen professors in charge of departments use the time of their instructors to promote their private practice and also to place a large amount of routine work upon graduate students and call it graduate work, in order to get a certain piece of work done in connection with their outside practice. Of course one may say this is an abuse of the opportunity granted the teacher and should not be permitted or it may be said that the graduate student or instructor is obtaining valuable experience. I grant that it is an abuse practically impossible to correct if commercial work is allowed and I also grant that the instructor and graduate student are obtaining valuable experience if they are permitted to have knowledge of the commercial details of the problems. There are very few teachers thus engaged who are not so rushed with work that they will take the time to discuss such details when they can get the work done without the bother of explanations. Furthermore, it is not always diplomatic for graduate students or instructors to raise any objection to such an arrangement.

I received a letter several years past from a graduate student in a large institution who stated that he was sorry he had registered for graduate work under a certain individual due to the criticism just stated. He was being used as a machine to solve a commercial problem for which the professor in charge of the work was receiving pay from a commercial firm not only for solving the problem but also pay from the college for the so-called instructional work given to the graduate students. Graduate work is supposed to be planned to develop original and individual thought, but the student did not know the object of the work and therefore was nothing more than a cog in the money-making device of the individual. It may be said that the illustration given is overdrawn; but I know of several cases similar to the above and I expect others can recall like observations or experiences.

There are too many teaching not as a profession but simply as a means for obtaining private consultation work, a stepping stone to something higher, or as a means to provide a living in case they do not obtain the desired income from the outside. Is this a fair deal for the man engaged in practical work alone? Is it right for a teacher of engineering who is paid at least a living wage to compete with the consulting engineer who is dependent upon his consultation alone for a living? To this statement, the general reply is advanced that the consulting engineer should have been familiar with this condition or fact before he entered commercial work.

I realize the ideal teacher is a man of broad culture and genial disposition; thoroughly versed in fundamental theory, well acquainted with the latest practice, and possessed of the teaching instinct and enthusiasm. I do not believe this ideal condition can be realized by sacrificing the efficiency of the teaching profession by divided fields of endeavor.

A PLEA FOR RATIONALLY CO-ORDINATED COURSES IN ANALYTICAL CHEMISTRY*

PAUL H. M. P. BRINTON, SCHOOL OF CHEMISTRY, UNIVERSITY OF MINNESOTA, MINNEAPOLIS

It is pretty generally admitted that students do not learn as much from our courses as we should like to have them learn; nor, indeed, as much as we feel they should learn. Many plans have been suggested for increasing the efficiency of teaching in nearly every grade of chemical instruction, and the widespread interest in these problems is evidence of the need for reform. In this paper the advisability of certain changes in the teaching of analytical chemistry will be discussed.

For some time it has been the opinion of the author that there was

* Read in the Division of Chemical Education of the American Chemical Society, at the Washington Meeting, April 24, 1924.

too sharp a division between the courses in qualitative and quantitative analysis, which resulted in the consideration of each branch as a separate subject, with consequent independence of method in the presentation of certain principles fundamental to both branches. The great majority of reactions used in quantitative analysis are used, or could be used, in qualitative analysis; and the converse is to a certain extent also true. It is conceivable, then, that if qualitative analysis were *thoroughly* taught there would be nothing left to present in a course of quantitative analysis beyond the details of technique, and the routine of the application of the reactions already studied. A glance at any one of a number of modern texts on introductory quantitative analysis will convince one that the authors of these books have no such confidence in the thoroughness of the instruction in qualitative analysis which their students are supposed to have had for the average strictly modern text-book on quantitative analysis seems to presuppose almost no knowledge of general reactions on the part of the students, and starts in with a presentation, in a most elementary way, of the fundamentals of chemical reactions, and in some cases with the very fundamentals of chemical science. And yet if we examine the average strictly modern text-book on qualitative analysis we gain the impression that nearly everything has been said about the theory of chemical reactions that could be said, and that there should surely be no cause for presentation of any more material of that sort in the course in quantitative work. A considerable part of the subject matter of the elementary courses in physical chemistry also would seem superfluous to one who had mastered one of the books on qualitative analysis. But let us go a step farther and examine one of our strictly modern texts on general chemistry. Here one is almost moved to question the raison d'etre of the theoretical parts of the book on qualitative analysis, to say nothing of the book on quantitative analysis.

To disarm the criticism that the writer is opposed to modern tendencies in the teaching of chemistry, tendencies which lean so strongly toward presentation of facts from the standpoint of a theoretical basis rather than from that of the old descriptive empiricism, it may be said that the whole object of this paper is to urge methods of presentation in analytical chemistry that will insure to the student a grasp of the subject in the light of the most recent acceptable theories of general, or so-called physical, chemistry. No truer words in the field of chemical pedagogy were ever spoken than those of the late Alexander Smith, in which he stated that constant repetition was necessary to enable students to grasp the significance of chemical facts and theories. So in spite of the opinions expressed in the preceding paragraphs, the writer is not opposed to repetition; but that repetition should be logical, progressive, and constructive.

The demands upon a student's time in the study of any science are

growing more severe each year, as the field broadens and the number of subjects necessary to mastery in that field increases. The strictest economy is therefore necessary in the planning of a student's curriculum, and the time alloted to any one branch of a given subject is being gradually cut down. This means that promiscuous overlapping of subject-matter must be avoided as much as possible, and a severe test is placed upon the teacher or the writer of a text-book in resisting the temptation to put into his course or book everything that appeals to him as interesting or (must we say it?) as calculated to impress his hearers or readers with the depth and breadth of his own knowledge. If the time given to a course were unlimited, there would be no objection to such expansion, for then the students could be made to really grasp the points presented, and the simpler and more fundamental facts and theories would not have to be slighted to make room for the more advanced conceptions. The fact that much fundamentally important elementary material is being elbowed out of our courses in general chemistry and qualitative analysis is recognized by many who are teaching more advanced courses; and the fact that there has not always been a compensating grasp of the more advanced conceptions, is attested by the delightful freshness with which students in quantitative analysis accept the presentation of the fundamental principles of chemical reactions,—a freshness which might almost lead the lecturer to suppose that he was planting his seeds of knowledge in virgin soil.

What is the remedy for this unsatisfactory condition of affairs? Of course no system of instruction will impress a clear image of chemical fundamentals upon the minds of the dull and hopelessly disinterested, but in the case of the student of average mentality and enthusiasm it is believed that a considerable improvement in his grasp of facts and principles can be made.

The plan proposed involves the writing of a series of text-books on analytical chemistry by one author, or by a group of authors working in closest co-operation. It is not the intention of the writer of this paper to enter upon this work, so it is hoped that some others may be moved to undertake such a series. The inclusion in this series of a text on general chemistry would also be desirable, but this is somewhat less feasible because of the large numbers of students who take general chemistry for its expansive cultural value alone, and who never go beyond the first year of college chemistry. For such students a more extensive treatment is perhaps justifiable, and since it is frequently impossible for students to tell until after their first course whether they will continue with chemistry, the contents of the general course will not be discussed in this paper.

The volume on qualitative analysis should present in clear, concise form the fundamentals of the theories of solutions, the elements of the mass law, and the other factors governing chemical reactions, but it need not deal

extensively with the proofs on which the acceptance of these conceptions is based. These arguments should have been presented in general chemistry, and they will be elaborated later in the courses in physical chemistry. On the other hand, the treatment of these subjects should be fairly elementary, and not worked out by elaborate mathematical examples. This should be left for the course in quantitative analysis. As now presented, courses in qualitative analysis are frequently more difficult than the quantitative courses which follow them, and this, of course, is not as it should be. If the efforts of the students in qualitative analysis were more definitely focused on the absolutely clear grasp of the simpler phases of the theoretical foundations of analytical chemistry, together with drill in valence and equation writing, the expenditure of the effort which is now so often dissipated through a fog of uncertainty would serve to lay a simple but sound foundation upon which a much more useful superstructure could be built in later courses.

In the volume on introductory quantitative analysis there should be a rational development, more rigorous and mathematical, of the principles given in the preceding volume; but this should be really a development, and not a re-statement, for the student should be constantly referred back to his volume on qualitative analysis, which should be regarded as a necessary part of his equipment for the quantitative course as truly as the quantitative text-book itself. In this way the confusion in the student's mind arising from presentation of the same theories in different order, and with different terminology, would be largely overcome. A student who has just at the close of the course in qualitative analysis begun to see the light is frequently submerged again in discouraging darkness when he comes to the course in quantitative analysis and finds that the lecturer is speaking about things with which the student feels some slight acquaintance, and yet which are presented in such a way that an entirely new mental grasp of the principles seems to be required. In time the good student will rise from the ruins of his former structure and accept and grasp the remodelled design, but that such a process is wasteful of time for the good student, and frequently disastrous to the poor or even average student, is almost certain.

It will naturally be objected by some that such a course would be narrowing in its effect on the student's horizon, but in answer it may be pointed out that the true horizon cannot be seen at all if the vision is clouded by a dense fog. We must first clear away the fog of ignorance and confusion which clouds the vision of the chemical student in his first two or three years of study, and then, and not until then, can we safely set about broadening his horizon by the presentation of facts from many diverse angles.

Constantly re-emphasizing to a student the importance of his foundations by frequent reference to his intelligible volume on qualitative analysis

would strengthen this foundation as no amount of newly devised illustration and explanation could do. For example, when in the quantitative laboratory a student is washing a precipitate of zinc ammonium phosphate with dilute ammonium phosphate solution, and he fails to get washings free from chloride test because he neglected the acidification of the tests with nitric acid, the instructor would render the greatest service to that student not by explaining the matter to him immediately, but by telling him to pick up his volume on qualitative analysis, which should be always at hand, and to refresh his memory as to the reaction between silver and phosphate ions.

It is hoped that the suggestions in this paper may lead to a more rational correlation of the courses in qualitative and quantitative analysis, and to the preparation of a unified series of two or three volumes on analytical chemistry. Even in the absence of such a series of text-books those in charge of various courses in analytical chemistry are urged to consider the advisability of covering less ground in each course, and insisting more firmly on the mastery by students of the material of the course. The realization that other courses are to follow the particular course under consideration would be helpful.

"BRANDS FROM THE BURNING"

ELLIOT Q. ADAMS, NELA RESEARCH LABORATORY, NATIONAL LAMP WORKS, CLEVELAND, OHIO

The plea for a pedagogical scrapheap in chemistry made by Professor Sy[1] must strike a responsive chord in the breast of every chemist. At the same time, as one who feels that he has in some cases "thrown out the baby with the bath," I am moved to defend some of the usages which he wishes to discard.

In the first place, it must be conceded that the primary purpose of chemical terms is neither that of being taught to beginners, nor that of being used by research workers, since the vast majority of those who use them are neither one nor the other; nevertheless it is on these two frontiers of chemical knowledge—the one where it meets new minds, the other where it encounters new facts—that the serviceability of chemical terms is most searchingly tested. If what is to follow seems to stress too much the point of view of research, my only defence is that chemical education and chemical industry—unlike John Alden—know well enough how to speak for themselves.

I share Professor Sy's objection to spending much of a beginner's time on reduction of gas volumes to zero centigrade, 760 millimeters, latitude 45° and sea level, but my reason is a bit different. I fear that the student

[1] J. CHEM. ED., **1**, 25 (1924).

will fail to see the forest for the trees; that the volume reduction, which is essentially physics, will obscure the law of simple volume relations in chemical reactions between gases, which is chemistry. From my own experience I can testify that many students get the idea that Avogadro's law holds only under "standard conditions."

As to memorizing atomic weights, boiling points, densities, etc., I feel that the student should be led to take toward them that attitude which professional chemists take; that it is not *necessary* to learn them, since they can always be looked up, yet a knowledge of the more commonly occurring values will save many times over the time spent in learning them. It seems to me that examinations can be framed to make a knowledge of such things helpful and yet not indispensable to passing the examination.

As to the law of multiple proportions, I feel that Professor Sy has left the Prince of Denmark out of his Hamlet. The significant fact about chemical compounds is not that they have constant composition—so has constant boiling hydrochloric acid—but that the combining weights of any given element in compounds with all sorts of other elements are integral multiples of a single fundamental value. This relation is clearest in the case of gases, and I believe, should be taught first there, and then extended to other states of matter. Or if solids appeal more to the student, Dulong and Petit's law could be made the starting point. So far from being true that there are few important examples of the law of multiple proportions, the elements in nearly all of the best known chemical compounds combine in other proportions to form compounds of whose existence even a beginner in chemistry should be aware, e. g., water and hydrogen peroxide; ammonia, hydrazine and hydrazoic acid; sulfuric acid, sulfurous acid, thiosulfuric acid, etc.; nitric acid, nitrous acid, hydroxylamine, etc. Even sodium hydroxide can be matched with sodium peroxide hydrate, leaving only hydrochloric acid out of the list of shelf reagents which does not illustrate the law.

As to the term "anhydride," I am sure the organic chemists need it too badly to surrender it without a struggle, and the use of the term in the general sense of any chemical compound obtained from another by abstraction of water and reconvertible into that other by combination with water could ill be spared. It would undoubtedly be well to avoid the misleading, if convenient, abbreviation "sulfuric anhydride" and to say "sulfuric acid anhydride" until the student realized that like "copper sulfate hydrate" it designates a substance which gives aqueous solutions identical with those given by the parent substance "sulfuric acid" or "copper sulfate" respectively.

I agree with Professor Sy's criticism of "dibasic acid" and "diacid base," and I believe the proper adjective is "divalent." The same substitution should be made for "diatomic" or "diacid" alcohols. "Dihydrionic acid" seems to me tautological.

As to *ortho*-phosphoric acid there *are* indeed other orthos. Any geological chemist knows the *ortho*silicates, any organic chemist the *ortho*formates and *ortho*carbonates, and most inorganic chemists have heard of *ortho*borates and *ortho*-aluminates. The term "ortho sulfuric acid" has lapsed into deserved oblivion; in it the prefix has a meaning incompatible with that in the better established cases.

The terms "oxidation" and "reduction" are misleading. As to the words for increase and decrease in valence, there are two as old as the science of chemistry that have never been used in any other way, namely dephlogistication and phlogistication.

HCl *is* hydrogen chloride, and anybody who knows what hydrogen is and what chlorides are will know what compound is meant. Just because for historical reasons we have a special name for ionizable hydrogen compounds is no reason to insist that it must always be used. The definition of an acid is loose. Acetic anhydride is "A substance containing hydrogen and when dissolved in water forming hydrogen ions." There is as much warrant for "hydrosulfic acid" as for "sulfate." Not having any objections to "hydrogen sulfide" the need does not seem to me especially urgent.

The ambiguity of the term "electrolytic dissociation" is a defect of the English language inherited, I believe, from the Greek. Just as "critical" may mean either "pertaining to a crisis" or "pertaining to a critic," so "electrolytic" may refer either to an electrolyte or to an electrolysis. I might add that there are those who prefer "electroclastic" to "electrolytic" when decomposition by passage of a current is meant.

The word "inflammable" is widely used outside of chemistry. So is "combustible," and for chemical purposes the two are synonymous.

Equivalent weights are a survival from the pre-Cannizzaronian days. It is convenient to have a name for the quotient obtained by dividing molecular weight by valence, but nobody should be compelled to use it.

It is illogical to speak of monatomic molecules after having told the student that a molecule is a combination of two or more atoms. The error, however; is in that definition of a molecule. In language we have syllables of one letter, words of one syllable, and sentences of one word. The letter "I" is a syllable and a word as well, and in Latin can be a sentence.

"Oxy-acid" is the accepted German usage, and should go the way of "atso," "netro" and "orto," so far as American usage is concerned.

Everybody knows the difference between a C-nitro compound and an O-nitro compound or nitrate. Similarly everyone knows the difference between anisol and cresol, or between phenyl hydroperoxide and quinol but we speak of methylation and oxidation, just the same. Until we distinguish between different kinds of methylation, oxidation, chlorination,

etc., it seems like straining at gnats to insist on having two kinds of "nitration."

As to the sugars, "triose" should not be used in two senses. By anology with diazo and disazo, trisazo, bisdiazo, etc., cane sugar is a bishexose. Dextrose and levulose are the obsolete terms, just because 1-dextrose and d-levulose are intrinsic jokes.

The naming of the aromatic *hydrocarbons* is a mess. If any changes are to be made it should be there. Benzyl alcohol is related as its name indicates to benzoic acid, but by analogy toluene should be "benzane" and benzene "phenane."

As to "ortho," "meta," and "para," I think the best policy is honesty: Tell the student that those three Greek prefixes are used to tell apart substances of the same empirical formula before we know enough to do anything more intelligent. If we succeed in getting consistency in a fairly wide field, as that of the benzene derivatives, that is unexpected good fortune. "Trialdehyde" is ambiguous. Many chemists believe both paraldehyde and metaldehyde to be triple polymers of acetaldehyde.

I agree with Professor Sy that attractiveness is more important in a beginning course than encyclopedic comprehensiveness. It is much better to leave the student with an appetite for more chemistry, than with a severe case of mental indigestion, but I do hope that chemical terminology will not be forced to lie on the Procrustean bed of chemistry for beginners.

A NEW HIGH SCHOOL COURSE IN CHEMISTRY*

CHARLES H. STONE, ENGLISH HIGH SCHOOL, BOSTON, MASS.

For a good many years, two courses in chemistry have been available at our school. The first of these, listed in the school catalogue as C 3, is an elementary course with two recitations and one double laboratory period a week. It is open to boys of the third year, but does not prepare them for college. The second course, denominated C 4, is a college preparatory course with one double and two single recitation periods and one double laboratory period per week. The single periods are 37 minutes long.

Two years ago it was thought best to limit the enrollment in C 4 to those boys who were preparing for college and to admit only members of the fourth year class. This ruling shut out the C 4 boys who had taken C 3 and who wished to take more chemistry but did not intend to go to college. It is for these boys, who now count up to a considerable number, that the new course has been planned.

* Delivered at the Boston Normal School, Feb. 2, 1924 before Asst. Supt. Gould's class in High School Organization.

In arranging material for the new course, a good many things had to be considered. There were psychological factors, utilitarian factors, and other matters, all of which had more or less bearing. Much thought was given to the question of presenting something different and, at the same time, interesting and psychologically valuable. It is believed that the awakening of interest is one of the first psychological steps, and that such interest, stimulated, strengthened, and directed into suitable channels, leads to quicker comprehension, increased initiative, and more rapid attainment of skill and power. Interest, enthusiasm, growth and power are steps in the intellectual ladder. With these, combine individual effort, provided for in the laboratory work especially, and we may hope for results worth while.

The psychological factors were:

Newness.—To the young mind the new thing makes a wider and stronger appeal than does the one already familiar. Since the pupils, for whom the new course has been arranged, have already some acquaintance with simple chemical facts and have some familiarity with elementary chemical processes such as the preparation of oxygen, hydrogen, carbon dioxide, etc., it was thought advisable not to include such experimental work in the new course, except as the preparation of such substances might be incidental to the preparation of some other substance. Where such simple routine work as filtering, evaporating, etc., may be necessary, it is to be carried out in connection with substances new to the student.

For the reasons given, our new course includes in its laboratory work no experiment which forms a part of the previous year's work in C 3.

Tangibility.—The usual high-school course follows the historic method and the major portion of the year's work is given to the study of the various gases. Criticism may justly be made against this method for there is little doubt that gases, especially the colorless ones (and most of them are colorless), are intangible substances to the mind of the young student. It was considered important, therefore, that the products of the student's work in the laboratory should possess certain definite and distinctive properties and should be susceptible of examination without the destruction of the entire sample. Obviously solids, chiefly, and liquids were to be chosen. Portions of these can be examined without destroying the integrity of the whole.

Usefulness.—It was also thought that each of the student's preparations should be adapted to some household or industrial use. A boy will naturally ask, after making a certain substance, "What good is it?" The real purpose, for example, of making copperas is to use it in dyeing a textile or in making some ink. Hence each of the substances selected for a laboratory preparation was subjected to the question "Has this substance a use which the student can appreciate?" and the second question was, "Can

the student make this use of the substance in the laboratory?" In practically every case each substance to be prepared by the student has passed this scrutiny and can be so utilized.

Simplicity.—An earnest effort has been made to include only such preparations as are within the power of the average student to make. A great many interesting substances were considered but their preparation was abandoned when it was found that the technical difficulties involved would call for more skill or knowledge than the student might fairly be supposed to possess. Too many or too great difficulties spell discouragement and too frequent discouragement spells failure.

Initiative.—Little by little the completeness of the directions for performing the experiments has been reduced with the idea of throwing the pupil more and more upon his own resources. If he learns to think, to stand on his own feet, to develop initiative, he will have acquired something of far more value than any collection of chemical recipes or stored-up chemical knowledge can ever be.

General Appeal.—In order that the laboratory work should have the most effective content it must make a general appeal. Unless the maximum of interest is maintained, the course will fail of its highest value. The work must be planned so that all pupils will find much of general interest and each pupil will find something of individual appeal.

Correlation.—Finally much thought has been given to the problem of bringing the work of both class room and laboratory into correlation with the previous year's work and also with the experience and environment of the student. It is now generally admitted that the pupil is the proper center of instruction. The course must revolve around him and its different aspects lie, as far as possible, within the limits of his experience but on the fringe of perception. To set the pupil at the task of preparing substances of which he never heard and whose use is unknown to him, leads to mystification. But the chemistry of such familiar substances as paint, soap, soda, gasoline, ink, salt, and the like is of interest because it touches in many ways his own experience and environment.

But there were utilitarian considerations to be thought of in arranging the course.

Motor Training.—The continuation of motor training in manipulation of apparatus begun in their previous year's work was to be continued and carried to a higher degree.

Use of Products.—It has been planned to have the products of the student's work in this course utilized, not only by himself as already indicated, but to have these products utilized in other classes.

As skill in manipulation and understanding of chemical methods increases, it is planned to utilize both in the preparation of larger quantities of chemicals for use in other classes. When a boy has reached a point

where you can send him out for a package of Arm and Hammer soda, two pounds, and have him convert the whole of it into sodium acetate crystals, he begins to think that chemistry is something more than playing with test-tubes and colored precipitates. It begins to have a reality unknown before.

Choice of Material.—At first it was somewhat doubtful just what could be chosen as the major theme of the course. Several lines seemed open. Fortunately we had previous experience that was helpful. Some years ago; a series of experiments was prepared on a few topics outside the usual course with the idea of affording to boys who showed ability and interest an opportunity to do additional work along some line of special appeal. A series of experiments, one set on The Chemistry of Textiles, another on Agricultural Preparations, and another on The Chemistry of Foods, was prepared for use in the laboratory. But these enlisted the interest of only a few students. Then a short list of experiments in the preparation of industrial chemicals was arranged and these enlisted more interest than did any or all of the others. It was therefore decided to make the preparation of industrial chemicals the main theme of the new course.

Obstacles.—But at once we were confronted by two obstacles. There was no available text which presented this aspect of chemistry and there was no known laboratory manual which could be used. It was decided to use selected portions of some standard text, and to write our own laboratory manual.

The Course.—The laboratory manual is nearly in a state of completion, but much still remains to be thought out as to the manner of adapting the texts selected to the laboratory work. It is intended to make the laboratory the central factor in the course, the recitation and other things revolving about the students' work in the laboratory.

The Specimens.—Directions for the preparation of these substances are given in the manual. It is the plan to utilize materials remaining from the usual experiments in a chemical course, and to use the raw material for other preparations. Thus the student is instructed how to work up the residues from the preparation of oxygen, hydrogen, and other substances. He is also instructed how to utilize such materials as a simple ore, salt, soft coal, clay, etc., in the preparation of other substances.

All of the specimens here shown were made in the laboratories of the English High School, most of them by one boy; a few are the work of other boys during the past few years, and a few are my own preparation made to supplement the work of the boy who had not had time to finish his own specimen. All of these were made in accordance with the directions in the manual, with very little help from me; in fact most of this boy's work was done without any help at all.

The first ten or so of the specimens here are the results of simple exer-

cises in the application of common industrial processes to the separation, purification, or preparation of common elements and compounds. Here for instance, are two tubes containing potassium chloride and manganese dioxide. They are what remains after making oxygen by the usual method. This tube contains ordinary alum, purified by crystallization. These two tubes contain crude and pure naphthalene. The pure product was obtained by sublimation. Here is benzol which was freed of a color impurity and from water by distillation and subsequent dehydration with calcium chloride which the student had previously prepared. Here is copper oxide obtained by the calcination of malachite ore and this tube contains copper obtained from the oxide by reduction with illuminating gas. This tube contains anhydrous zinc sulphate, obtained from the waste remaining after making hydrogen from zinc and sulphuric acid. This yellow substance is barium chromate which may be used as a color for paint. These various samples of different salts show how larger quantities may be successfully prepared in the laboratory. In fact, most of the sodium acetate we use during the year is made by some boy who is interested and willing to undertake the task of making a rather large quantity.

Here is a project: To make some ink from iron nails. The first step is to prepare copperas which is shown here. From copperas and tannic acid we get black ink which this tube shows. Copperas is also used in the dyeing of certain goods; it acts as a mordant. This cloth was mordanted with copperas and then dyed.

These two tubes carry an interesting story. The first contains some crushed magnesite rock, a common mineral; the second contains Epsom salt, made from the magnesite rock. If you doubt it, taste of the sample. This is sodium acid phosphate, a substance used in medicine. This yellowish liquid is concentrated hydrochloric acid made in the laboratory from common salt, and this is Glauber's salt, worked up from the residues of the hydrochloric acid preparation. Glauber's salt is largely used in dyeing, as an assistant. This wool was dyed in wool yellow with Glauber's salt as an assistant.

Nitric acid was made, but it is so corrosive it was thought best to work it up into other substances. Here is one: it is barium nitrate, used in fireworks to give a green color to the stars in the rocket.

Here is one of the most interesting ones. The project is to dye a piece of goods with a dye of your own manufacture. We begin with a piece of lead. When lead is heated with Chile saltpeter, two products form: one of them is lead oxide shown here, and the other is sodium nitrite. Now when sulphanilic acid is diazotized with some of the student's nitrite and hydrochloric acid, and the resulting compound coupled with beta-naphthol an orange dye is produced. Here is some of the dye and this skein of wool was dyed with this dye.

This is sodium bisulphite used in bleaching straw and other materials. This bottle contains photographer's hypo. Here is Mosaic gold used in gilding radiators. Glass etching is represented by this tube with the boy's name on it. These tubes contain the well-known washing soda and caustic soda used in the manufacture of soap. Here is boric acid made from borax and used as an eye wash and antiseptic. This match, the last of a large family, shows one of the uses of phosphorus.

Method of Work.—In all this work our aim has been to bring the chemistry of common substances to the student's attention. We hope to approach, in some small degree, the methods of the industrial factory. The following may be mentioned.

The installation of a few simple pieces of apparatus on a small scale operating on the same principles as the larger machines of the factory is one of our dreams. Excursions to neighboring plants where various phases of chemical industry are carried on is another which we hope to see realized. Finally as a means of concentrating attention on some one theme we plan to have each boy prepare a little booklet on some topic, such as Copper, for example. He will secure pictures, articles, make drawings, and read up about copper, and in the laboratory prepare a number of copper compounds. The whole of his effort could then be put into the form of an illustrated booklet.

Conclusion.—How successful these preparations will be in arousing interest in a class of boys we shall learn next year. We do not expect that the course as now arranged will prove entirely satisfactory. It is frankly an experiment. Experience will show, no doubt, where improvement may be made. Some of the present experiments may be thrown out and others substituted. But we feel that a start has been made in the right direction in giving to boys not desiring a college preparation an opportunity to make a close acquaintance with the chemistry of things common to their environment or of large use in the industrial world.

Local Activities and Opportunities

Wisconsin Chemistry Teacher's Association. On Nov. 5, the chemistry teachers of Wisconsin organized as a section of the Wisconsin State Teacher's Association. The plans and aims of the Chemistry Association were presented by Dr. J. H. Mathews, director of the Chemistry Department at the University of Wisconsin. The officers of the new section are: Chairman, A. P. Minsart, Wausan, Wis.; Secretary, T. R. Moyle, Milwaukee, Wis.; Contributor Editor, M. Wodleigh, Milwaukee, Wis.

The executive committee consists of the officers of the section and Dr. Mathews who has been requested to act in an advisory capacity. The committee is formulating careful plans for the future work of the section, and will report such plans in a later issue of *THIS JOURNAL*.

Chicago Association of Chemistry Teachers. The Chicago Section of the American Chemical Society has organized the fifth group meeting in connection with the regular monthly meeting. It bears the label, "Chemical Education." About thirty teachers discussed the subject, "How to Develop Appreciation for Chemical Knowledge." Mr. C. E. Osborne of Oak Park showed how it was possible to "sell" chemical knowledge not only to his pupils but the public as well. He presented the following plans:

1. Open house to the public one evening each year.

Numerous pupils have charge of exhibits on various topics such as electro-plating, baking powder, testing textiles, gas making, etc. The chemical processes of these subjects are explained as the work is demonstrated by pupils appropriately dressed for the work. Appreciation by both pupil and parent is developed at the same time.

2. Bulletin board of the chemistry of current events.

3. Addressing community clubs and social organizations on the chemistry of every-day topics.

4. Study of the chemistry of subjects of local interest.

5. Requiring pupils to read Creative Chemistry during the first semester.

6. Prize essay contest.

The discussion brought out the point that time spent in developing appreciation of chemical knowledge was largely regained by the increased activity of the pupil.

But with the development of appreciation of chemical knowledge, especially in the subjects of local interest, and the general increase of subject matter appearing in current textbooks, there is a grave possibility of neglecting the basic principles of the science. Mr. A. A. McLeod of Crane Junior College showed the necessity of agreement among teachers of chemistry on the fundamental principles of the subject. Any list of such fundamentals should be sufficiently limited so that every teacher of chemistry in secondary schools would have time to prepare his pupils thoroughly in them without using the whole school year for it. The first year of chemistry so standardized is a suitable basis for further study in college or daily life activity.

Dr. J. Elliott Gilpin. On Nov. 28, at the first meeting since the death of Dr. Gilpin, the Maryland Association of Chemistry Teachers passed the following resolution:

WHEREAS, on August 25, 1923, Dr. J. Elliott Gilpin was claimed by death, whereby the Maryland Association of Chemistry Teachers suffered the loss of its first President, therefore, be it resolved:

1. That the Association feels keenly the loss of one who for so long has faithfully performed the duties of a teacher of Chemistry, and

2. That the Association is deeply appreciative of the efforts of its late President in furthering the interest of students in chemistry, and

3. That the Association hereby expresses its sympathy with the bereaved family.

Columbia University. The $900,000.00 chemistry building for which Columbia has been waiting is now to be realized. Ground has been broken and it is expected that the work may proceed without any great delay.

University of Oklahoma. Dr. H. C. George has recently been appointed as professor of petroleum engineering at the University of Oklahoma. He has been formerly employed by the United States Bureau of Mines.

University of Wisconsin. Dr. Glenn S. Skinner has recently resigned his position as professor of chemistry at the University of Wisconsin and Dr. H. N. Calderwood, Jr., has been appointed in his place.

University College, London. On Nov. 12, the Ramsay Laboratory of Chemical Engineering was opened at University College, London. Very careful plans have been formulated for the work in this new laboratory.

North Carolina College for Women. Dr. P. M. Ginnings has been appointed as professor of Chemistry at North Carolina College for women.

Professor S. W. Parr has returned from the American Gas Association meeting where he, as chairman of the Low Temperature Carbonization Section of the Committee on Carbonization and Complete Gasification of Coal, gave a report. Professor Parr felt that the outstanding report at

this meeting was one which showed the tremendous and rapid progress which is being made on "House Heating by Gas."

Professor Roger Adams spoke before the Missouri Section of the American Chemical Society, Columbia, Missouri, on the "New Developments in the Field of Catalysis," October 30,1924

Dr. R. L. Jenkins, Ph.D., University of iIllinos, 1923, has returned to this country after a year at Lyons, France, where he has been working under the direction of Professor Grignard. Dr. Jenkins is an industrial fellow at Mellon Institute, Pittsburgh.

W. B. Holton has returned to the staff of the Inorganic Division after a year of graduate work at the California Institute of Technology, Pasadena, California.

Dr. F. H. Driggs, instructor in the Inorganic Division here, was married this summer to Helen Freeman, of Urbana, Illinois.

J. B. Taylor, formerly of the Hercules Powder Company, Kenville, New Jersey, is back as assistant in the Physical Division.

B. S. Garvey, B.S., in 1921, Illinois, is now a graduate student after two years of teaching at Boone University, Wuchang, China.

Recent Books

Introduction to General Chemistry, by WILLIAM FOSTER. Princeton University Press, Princeton, N. J., 1924. 643 pages. Price $3.50.

To anyone who has had the privilege of listening to Professor Foster's lectures, this book will offer no surprises. It is the product of fifteen years' experience, including a year of trial with his own classes. It embodies the clarity and simplicity of his lectures with the wealth of detail, explanation and example proper to a textbook. It steers a straight course between the extremely descriptive and extremely theoretical types of freshman texts. The human interest is preserved at all times by extensive references to the practical application of the subject. An excellent series of portraits of eminent chemists serves to enhance its value still further. The latest advances on the frontiers of chemistry are not neglected.

Details of arrangement that commended themselves to the reviewer are the early introduction of symbols and equations, a summary at the end of all the earlier chapters, questions at the end of each chapter, and a group of 221 problems at the end of the book.

The chapters on ionization are very well written. Professor Foster's chapters on Valence and Nomenclature, Molecular and Atomic Weights, Energy and Chemical Change, Structure of Matter, Radioactivity, the Food of Plants and Animals, Colloids, and Metals and Alloys are excellent. They appeal even to the advanced chemist.

This book should be in the library of every teacher of Freshman Chemistry and no mistake will be made in adopting it for class use.

MALCOLM M. HARING.

A Laboratory Manual in General Chemistry, by WILLIAM FOSTER. Princeton University Press, Princeton, N. J., 1924. Pages IX. 205. Price $2.00.

This book was written to accompany the author's "Introduction to General Chemistry." It is the culmination of laboratory notes and manuals written by Professor Foster and used by his classes for many years. It shares the excellence of the textbook mentioned above.

This manual does not contain quite as many individual experiments as some other now in use, but there is an ample number for any thorough laboratory course. The selection of topics and experiments is very good.

Features that make it stand out from other manuals are a list of reference books to use in the laboratory, a thorough-going chapter on chemical operations including weighing and its accompanying manipulations, a table of 4-place logarithms, an excellent chapter on blowpipe and dry way analytical tests, and abundance of questions, plenty of volumetric analyses, a free use of notes containing somewhat difficult and obscure explanations on the subject matter, the inclusion of complicated equations immediately following the place where the reaction is called for, a chapter on qualitative analysis, etc. Plenty of originality and mental effort is required of the student, but the time consuming and ofttimes discouraging "book research" for obscure and difficult points is eliminated wherever possible. Under Ba and Sr we find a thorough discussion of the solubility product principle and hydrolysis is illustrated by precipitating $Al(OH)_3$ with $BaCl_2$.

MALCOLM M. HARING.

AUTHOR INDEX
Journal of Chemical Education
Volume 1, 1924

ADAMS, ELLIOT Q. Brands from the Burning (Abstract, p. 80) 230

BAILEY, C. H. The Teaching of Biochemistry (Abstract) 188
BAKER, R. A. Position of the Metals in the Introductory Course (Abstract, p. 79). 219
BLAND, G. D., WITH W. L. EVANS, J. E. DAY AND C. S. PEASE. The Vapor Density of Steam 152
BOWERS, W. G. The Advantages of Laboratory Work in the Study of Elementary Chemistry 205
BRAUTLECHT, C. A. Correlation of Laboratory, Recitation and Lecture Work in General Chemistry (Abstract) 189
BRINTON, PAUL H. M. P. A Plea for Rationally Coördinated Courses in Analytical Chemistry (Abstract, p. 79) 226
CARTLEDGE, G. H. Physical Chemistry for Undergraduates (Abstract, p. 61) 119
Book Review: Elementary Qualitative Analysis—Reedy 216
CHAPIN, WILLIAM H. A College Course in Analytical Chemistry 48
CLARK, JOHN D. The Kinetic Theory—An Example of Right Thinking 75
COLBERT, J. C., AND JACOB CORNOG. What We Teach Our Freshmen in Chemistry 5
COPE, FRED F. Play Ball in Chemistry ... 181
CORNOG, JACOB, WITH J. C. COLBERT. What We Teach Our Freshman in Chemistry 5
DAVISON, HERBERT F. A New Lecture Table Outfit for Demonstrating Conductivity to Elementary Classes 74
DAY, JESSE E., WITH W. L. EVANS. Laboratory Exercise in Atomic Structure (Abstract, p. 78) 100
DAY, JESSE E., WITH W. L. EVANS, C. S. PEASE AND G. D. BLAND. The Vapor Density of Steam 152
DELY, J. G. The Chemist: His Education and His Job 115
DEMING, HORACE G. Taking Note of the Mist in Chemistry (Abstract) 60
DONNAN, F. G. The Status of Chemical Education in England (Abstract) 189

EDMISTON, R. W. The Chemistry Hobby .. 43
ELLIOT, FELIX A. Motion Pictures as an Aid in Teaching Chemistry (Abstract). 190
EVANS, WILLIAM LLOYD, WITH JESSIE E. DAY. Laboratory Exercise in Atomic Structure (Abstract, p. 78) 100
WITH J. E. DAY, C. S. PEASE, AND G. D. BLAND. The Vapor Density of Steam. 152

FERGUSON, ALFRED L. The Course in High School Chemistry (Abstract, p. 60) 183
FRAZER, J. C. W. New Chemical Laboratory 69
Gardner, J. H. Book Review: Chemical Synthesis—Hepworth 216
Aniline and Its Derivatives—Groggins ... 136
Applied Chemistry—Garard 170
Organic Chemistry for Advanced Students, 4th ed. Cohen 84
Textbook of Cellulose Chemistry—Heuser, West and Esselen 136
What Industry Owes to Chemical Science—Pitcher, and Butler-Jones 170
GLENN, EARL R. Problems Associated with the Construction of a High School Chemistry (Abstract) 80
GORDON, NEIL E. Book Review: Eminent American Chemists—Killeffer 169
Status of Chemical Education in the United States (Abstract) 190
HALE, HARRISON. A Promising Field of Chemical Education 203
HARING, MALCOLM M. Book Review: Study and Quiz Outline—Evans 64
College Chemistry Companion—Kendall. 169
Laboratoy Manual in General Chemistry—Foster 240
Introduction to General Chemistry—Foster 240
HEDGES, C. C. Should Teachers Do Research or Commercial Work? (Abstract, p. 79) 222
HIGLEY, G. O. An Adjustable Atomic Model (Abstract) 190
HOLMES, HARRY N. COLLEGE RESEARCH. Instruction in Colloid Chemistry (Abstracts) 190
HOPKINS, B. S. A New Covering for Laboratory Table Tops (Abstract, p. 59) 209
The Need of Trained Teachers in Chemistry 35
HOWARD, S. F. AND T. A. MARTIN. The Difference between the Half-Sum and the Square Root of the Product When Weighing by the Method of Gauss (Abstract, p. 80) 211
HUTCHINS, ROLAND B. Should the Electron be Included in High School Chemistry? (Abstract, p. 59) 145

IRVINE, J. C. Status of Chemical Education in Scotland (Abstract) 189

JAMES, J. H. Chemical Engineering Education (Abstract, p. 80) 153

KELLOGG, VERNON. National Research Council 23
KENDALL, JAMES. The Calculation of the Formula of a Compound from its Percentage Composition (Abstract) 190
KILLEFFER, D. H. Chemical Education via Radio 43
KIPLINGER, C. C. In and Out of the Classroom with Dr. Edward Williams Morley (Abstract, p. 79) 129
KRAEMER, ELMER O. Movies in the Service of Science 199

LANSING, JOHN E. Qualitative Analysis in the Freshman Course 72

MCGILL, M. V. A Live Chemistry Club in High School 31
Course in Chemistry being Developed at the Lorain High School, Lorain, Ohio (Abstract) 59
MARTIN, T. A., WITH A. F. HOWARD. The Difference between the Half-Sum and the Square Root of the Product When Weighing by the Method of Gauss (Abstract, p. 80) 211
MATTERN, LOUIS W. Book Review: Fundamentals of Chemistry—Gray, Sandifur and Hannah 114
MELLON, M. G. Calculating the Results of a Volumetric Analysis 127

MULLIKEN, S. P. What is the Best Type of a Course in Qualitative Organic Analysis (Abstract)..... 188
MULLINEX, R. D. Qualitative Analysis without Hydrogen Sulfide..... 67

NEWELL, LYMAN C. The Teacher's Vow.. 213
NOYES, W. A. Status of Chemical Education in Germany and France (Abstract) 190

OSBORNE, C. E. Making High School Chemistry Worth While..... 104

PATRICK, W. A. What Kind of Research is Essential to Good Teaching?..... 16
PEASE, C. S., WITH W. L. EVANS, J. E. DAY, AND G. D. BLAND. The Vapor Density of Steam..... 152
POWERS, S. R. Tests of Achievements in Chemistry (Abstract, p. 60)..... 139

SALATHE, ALBERT. Meeting the Needs of the Freshman Chemistry Class..... 61
SCIENCE SERVICE. National Academy.... 113
New Fields of Magnetic Iron..... 40
SEARS, GEO. W. A New Form of Periodic Table as a Practical Means of Correlating the Facts of Chemistry..... 173
SEGERBLOM, WILHELM. Book Review: A Diagnostic Study of the Subject Matter of High School Chemistry—Powers... 196
Charts of Chemical Reactions of the Common Elements..... 114
SLOSSON, EDWIN E. Educating Everybody 3
SMITH, HERBERT R. The Response of High School Pupils to Chemical Education..... 12
STONE, CHARLES H. The High School Chemistry Course versus the College Requirement..... 55
A New Course in High School Chemistry 233
SY, A. P. A Plea for a Pedagogical Scrapheap in Chemistry..... 25

TURNER, HAROLD J. Chemical Reactions Visualized for Beginners..... 132

SUBJECT INDEX

Journal of Chemical Education

Volume 1, 1924

ABSTRACTS:

Ithaca Meeting 188
Washington Meeting 59, 78
Advantages of Laboratory Work in the Study of Elementary Chemistry. W. G. Bowers 205
Agriculture Chemistry, The Teaching of. Ross Aiken Gortner, J. W. Read, and H. R. Kraybill 177

ANALYTICAL CHEMISTRY:

A College Course in Analytical Chemistry. William H. Chapin, ... 48
A Plea for Rationally Coördinated Courses in Analytical Chemistry. Paul H. M. P. Brinton, (Abstract p. 79) 226
Qualitative Analysis in the Freshman Course. John E. Lansing, (Abstract). 72
Qualitative Analysis Without Hydrogen Sulfide. R. D. Mullinix, (Abstract).. 67
Volumetric Analysis, Calculating the results of a. M. G. Mellon, (Abstract) 127
Weighing by the Method of Gauss, the Difference between the Half-Sum and the Square Root of the Product. S. F. Howard and T. A. Martin (Abstract p. 80) 211
What is the Best Type of Course in Qualitative Organic Analysis. S. P. Mulliken (Abstract) 188

Biochemistry, the Teaching of. C. H. Bailey (Abstract) 188
Book Reviews...64, 84, 114, 136, 169, 196, 216
A Laboratory Manual in General Chemistry, by William Foster. M. M. Haring 240
Aniline and its Derivatives, by P. H. Groggins. J. H. Gardner 136
Applied Chemistry, by Ira D. Garard. J. H. Gardner 170
Charts of the Chemical Reactions of the Common Elements, by John A. Timm. Wilhelm Segerblom 114
Chemical Synthesis, by Harry Hepworth. J. H. Gardner 216
College Chemistry Companion, by James Kendall. Malcolm M. Haring 169
Diagnostic Study of the Subject Matter of High School Chemistry, by S. R. Powers. Wilhelm Segerblom 196
Elementary Qualitative Analysis, by J. H. Reedy. G. H. Cartledge 216
Eminent American Chemists, by D. H. Killeffer. Neil E. Gordon 169
Fundamentals of Chemistry, by C. W. Gray, C. W. Sandefur and H. J. Hanah. Louis W. Mattern 114
Introduction to General Chemistry, by William Foster. M. M. Haring 240
Organic Chemistry for Advanced Students, by Julius B. Cohen. J. H. Gardner 84
Study and Quiz Outline, by Wm. Lloyd Evans. Malcolm M. Haring 64
Textbook of Cellulose Chemistry, by Emil Heuser, West & Esselen. J. H. Gardner 136
What Industry Owes to Chemical Science, by Richard B. Pitcher, and Frank Butler Jones. J. H. Gardner.. 170
Calculation of the Formula of a Compound from its Percentage Composition, James Kendall (Abstract) 190

CHEMICAL EDUCATION:

A Promising Field of Chemical Education. Harrison Hale 203
Chemist, The: His Education and His Job. J. G. Dely 115
Educating Everybody. Edwin E. Slosson 3
Mist in Chemistry, Taking Note of the. H. G. Deming (Abstract) 60
England, The Status of Chemical Education in. F. G. Donnan (Abstract).... 189
France, The Status of Chemical Education in. W. A. Noyes (Abstract).... 190
Germany, The Status of Chemical Education in. W. A. Noyes (Abstract)... 190
Progress of Committee of Chemical Education. Neil E. Gordon, *et al.*.....33, 158
Response of High School Pupils to Chemical Education. Herbert R. Smith.... 12
Scotland, The Status of Chemical Education in. J. E. Irvine (Abstract)..... 189
Trained Teachers in Chemistry, The Need of. B. S. Hopkins (Abstract)..... 35
United States, The Status of Chemical Education in. Neil E. Gordon (Abstract) 190
Via Radio, Chemical Education. D. H. Killeffer 43
Chemical Engineering Education. J. H. James 153
Chemical Laboratory, New. J. C. W. Frazer 69
Chemical Reactions Visualized for Beginners. Harold J. Turner 132
Chemist, His Education and His Job. J. G. Dely 115

CHEMISTRY CLUBS:

A Live Chemistry Club in High Schools. Martin V. McGill 31
Chemistry Hobby. R. W. Edmiston..... 167
Chemistry Teachers, Organization of..... 200
Chlorine, A "Painless" Method for Preparation of (Abstract). Jacob Cornog.. 79
Colloid Chemistry, Instruction in. Harry N. Holmes (Abstract) 190
College Requirements, High School Courses versus the. Charles H. Stone..... 55
College Research. Harry N. Holmes..... 81
Conductivity Measurements, A New Lecture Table Outfit for Demonstrating. Herbert F. Davison 74

CONSTITUTIONS:

Division of Chemical Education of the A. C. S. 192
New England Association of Chemistry Teachers 201

COMMITTEES:

Agricultural Chemistry 177
Chemical Education 33, 158
Prize Essay Contest of A. C. S. 161
Correlation of High School and College Chemistry. Neil E. Gordon, *et al.*.... 87
Correlation of Laboratory, Recitation and Lecture Work in General Chemistry. C. A. Brautlecht (Abstract)..... 189

COURSES IN CHEMISTRY:
College.....5, 55, 61, 67, 72, 87, 153, 205, 226
High School.....12, 55, 87, 104, 145, 203, 233
Course in Chemistry being Developed in the Lorain High School. Martin V. McGill (Abstract)..... 59
Covering for Laboratory Table Tops. B. S. Hopkins..... 209
Editor's Outlook.....1, 21, 41, 65, 85, 137, 171, 197, 217
Educating Everybody. Edwin S. Slosson..... 3
Education of the Chemist. J. G. Dely..... 115
Electron Theory, Should it be Included in High School Chemistry. Roland B. Hutchins (Abstract p. 59)..... 145
Elementary Chemistry, The Advantages of Laboratory Work in the Study of. W. G. Bowers..... 205

Freshman Chemistry Class, Meeting the Needs of. Albert Salathe..... 61
Freshman Course, Qualitative Analysis in the. John E. Lansing..... 72
Freshmen in Chemistry, What We Teach Our. Jacob Cornog, and J. C. Colbert..... 5

High School and College Chemistry, Correlation of. Neil E. Gordon, *et al*..... 87
High School, The Course in. Alfred L. Ferguson (Abstract p. 60)..... 183
High School Chemistry Course Versus the College Requirement. Charles H. Stone..... 55
High School Chemistry, A New Course in. Charles H. Stone..... 233
High School Chemistry Worth While, Making. C. E. Osborne..... 104
Hydrogen Sulfide, Qualitative Analysis Without. R. D. Mullinix..... 67

Introductory Course, The Position of the Metals in. R. A. Baker (Abstract p. 79)..... 219
Iron, New Fields of Magnetic. Science Service..... 40

Ithaca, Meeting of the A. C. S.:
Abstracts of..... 188
Minutes of..... 191

Kinetic Theory, An Example of Right Thinking. John D. Clark..... 75

LABORATORY METHODS:
Atomic Structure, Laboratory Practice in. William Lloyd Evans, and Jesse E. Day (Abstract, p. 78)..... 100
Chlorine, A "Painless" Method for Preparation of. Jacob Cornog (Abstract)..... 79
Laboratory Work, Advantages of, in Elementary Chemistry. W. G. Bowers.. 205
Conductivity, Lecture Table Outfit for Demonstrating to Elementary Classes. Herbert F. Davison..... 74
Vapor Density of Steam, The. W. L. Evans, J. E. Day, C. S. Pease, and G. D. Bland..... 152

LABORATORY CONSTRUCTION:
Laboratory Table Tops, A New Covering for. B. S. Hopkins (Abstract p. 59).. 209
New Chemical Laboratory. J. C. W. Frazer..... 69
Laboratory Table Tops, A New Covering for. B. S. Hopkins..... 209
Lecture Table Outfit for Demonstrating Conductivity to Elementary Classes, A New. Herbert F. Davison..... 74
Local Activities and Opportunities..... 18, 38, 63, 82, 112, 135, 168, 195, 214, 239

Magnetic Iron, New Fields of. Science Service..... 40
Minutes of Meetings of Division of Chemical Education of the A. C. S.:
Ithaca Meeting (Sept. 1924)..... 191
Washington Meeting (Apr., 1924)..... 110
Morley, Edward Williams, In and Out of the Class Room with. C. C. Kiplinger... 129
Movies in the Service of Science. Elmer O. Kraemer..... 199
Motion Pictures as an Aid in Teaching Chemistry (Abstract). Felix A. Elliott..... 196

National Academy, News of. Science Service..... 113
National Research Council. Vernon Kellogg..... 23
National Prize Essay of the A. C. S. H. E. Howe, *et al*..... 161
Need of Trained Teachers in Chemistry. B. S. Hopkins..... 35

NOMENCLATURE:
Brands from the Burning. Elliot O. Adams (Abstract, p. 80)..... 230
Pedagogical Scrapheap in Chemistry, A Plea for a. A. P. Sy..... 25
Opportunities, Local Activities and..... 16, 36, 63, 82, 112, 135, 168, 195, 214, 239
Order of Topics in General Chemistry. R. A. Baker.....—219
Organization of Chemistry Teachers (New England)..... 200

Periodic Table, A New Form of, as a Practical Means of Correlating the Facts of Chemistry. Geo. W. Sears..... 173
Physical Chemistry for Undergraduates. G. H. Cartledge (Abstract p. 61)..... 119
Play Ball in Chemistry. Fred F. Cope... 181
Prize Essay Contest Report of A. C. S. National. H. E. Howe, *et al*..... 161
Problems Associated with the Construction of a High School Chemistry Course. Earl R. Glenn (Abstract)..... 80
Promising Field of Chemical Education, A. Harrison Hale..... 203
Qualitative Analysis without Hydrogen Sulfide. R. D. Mullinix..... 67
Qualitative Analysis in the Freshman Course. John E. Lansing..... 72

Radio, Chemical Education via. D. H. Killeffer..... 43
Research, College. Harry N. Holmes.... 81
Research Council, National. Vernon Kellogg..... 23
Research is Essential to Good Teaching, What Kind of. W. A. Patrick..... 16
Research or Commercial Work, Should Teachers do (Abstract p. 79). C. C. Hedges..... 222
Response of High School Pupils to Chemical Education. Herbert R. Smith..... 12

Something Done and an Opportunity. H. E. Howe, *et al*..... 161

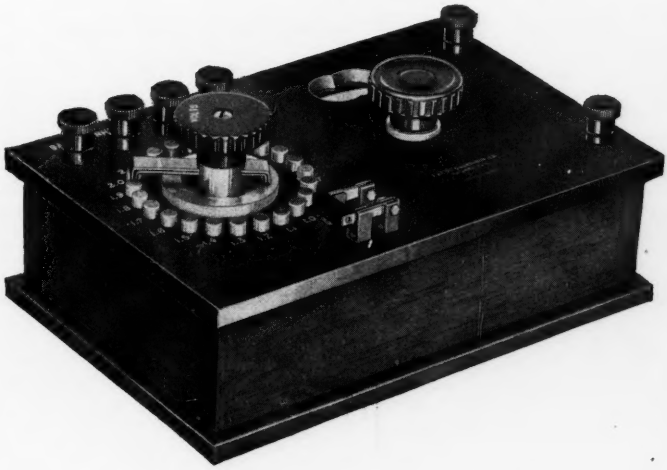
Taking Note of the Mist in Chemistry. H. G. Deming (Abstract)..... 60
Teacher's Vow. Lyman C. Newell..... 213
Tests of Achievements in Chemistry (Abstract p. 60). S. R. Powers..... 139

Use for This Journal, A New (Note)..... 134

Vapor Density of Steam, The. W. L. Evans, J. E. Day, C. S. Pease, and G. D. Bland..... 152
Volumetric Analysis, Calculating the Results of a. M. G. Mellon..... 127

WASHINGTON MEETING:
Abstracts of 59, 78
Minutes of 110
Weighing by the Method of Gauss, The Difference between the Half-Sum and the Square Root of the Products When. S. F. Howard and T. A. Martin 211
Women's Clubs, Chemistry in. Harrison Hale 203

Students' Potentiometer



The Students' Potentiometer includes the calibrated portion of the potentiometer measuring apparatus. It retains the desirable educational features of the simple slide wire in that the student is required to make the connections to the component parts of the assembly. In design, the instrument is patterned after the Type K Potentiometer, so that the student gains practice in the operation of an instrument of the precision type.

The fundamental range of the Students' Potentiometer is 2.3 volts. This may be extended by the use of volt boxes.

The slide wire, representing 100 millivolts, is graduated into 100 divisions, and is easily readable to .5 division or .5 millivolt, which is the guaranteed accuracy of the instrument.

Provision is made for the use of the slide wire, with or without end coils, as a simple Kohlrausch slide wire.

7651 Students' Potentiometer.....**$80.00**

Details concerning the Students' Potentiometer are given in Bulletin 765-D.

LEEDS & NORTHRUP COMPANY

ELECTRICAL MEASURING INSTRUMENTS

4901 Stenton Avenue **Philadelphia, Pa.**

CLEARANCE SALE

"S. C. P." JAPANESE PORCELAIN WARE

AT 60% REDUCTION FROM CURRENT PRICES

With the increased production and superior quality of American laboratory porcelain ware, the maintenance of stocks of "S. C. P." Japanese porcelain ware, as listed in the current edition of our catalogue LABORATORY APPARATUS AND REAGENTS, seems no longer advisable, particularly since increased costs now current in Japan obviate any immediate possibility of price advantage on the imported ware.

Remaining stocks of "S. C. P." Japanese porcelain ware as listed in our catalogue under the numbers shown on opposite page are now offered, therefore, subject to prior sale at ***60% reduction from current prices.***

This offer applies only to the shapes and sizes listed on opposite page and is subject to withdrawal without notice. Orders will be filled in rotation as received. Because of the small unit prices on some of the items, we request that selection be made to total at least $5.00.

The ware now offered is of the same excellent quality as that sold by us since 1915 and of which comparative tests have been frequently published. For several years after the outbreak of the war, it was the only available porcelain ware of thoroughly satisfactory quality and ample production.

Those in charge of educational laboratories will find it advantageous to provide for student requirements from this stock.

The shapes and sizes available in this special offer are as follows:

2863. CASSEROLES, S. C. P. Porcelain, glazed inside and outside, and with porcelain handle.

Capacity, ml	30	150	750	1250	2000
Current price each	.40	.79	2.42	3.52	5.28
Clearance Sale price each	**.16**	**.30**	**.95**	**1.40**	**2.10**
Stock on hand	220	318	330	295	189

3860. COMBUSTION BOATS, S. C. P. Porcelain, glazed throughout.

Size, mm	60 x 10	100 x 18	145 x 14
Current price each	.25	.57	.70
Clearance Sale price each	**.10**	**.20**	**.25**
Stock on hand	230	1080	652

(***Continued on opposite page***)

ARTHUR H. THOMAS COMPANY

RETAIL—WHOLESALE—EXPORT

LABORATORY APPARATUS AND REAGENTS

WEST WASHINGTON SQUARE PHILADELPHIA, U. S. A.

CABLE ADDRESS "BALANCE," PHILADELPHIA

CLEARANCE SALE

"S. C. P." JAPANESE PORCELAIN WARE

AT 60% REDUCTION FROM CURRENT PRICES

3877. COMBUSTION CAPSULES, S. C. P. Porcelain, glazed throughout except outside bottom. Without lip.

Size	45 mm. diam. x 22 mm. deep	50 mm. diam. x 30 mm. deep
Current price each	.26	.30
Clearance Sale price each	**.10**	**.12**
Stock on hand	1425	172

4124. CRUCIBLES, S. C. P. Porcelain, high form, glazed throughout except outside bottom. Without covers.

Capacity, ml	10	30	57
Current price each	.14	.29	.36
Clearance Sale price each	**.05**	**.10**	**.14**
Stock on hand	1200	2750	320

4130. CRUCIBLES, S. C. P. Porcelain, as above, but low wide form.

Capacity, ml	2	8	12	17	30	50	90	145	265
Current price each	.08	.15	.17	.22	.27	.40	.46	.52	.68
Clearance Sale price each	**.03**	**.06**	**.07**	**.08**	**.10**	**.15**	**.18**	**.20**	**.25**
Stock on hand	327	1350	2800	3000	1800	490	2	477	210

4136. CRUCIBLES, GOOCH, S. C. P. Porcelain, glazed throughout excepting outside bottom. With fixed bottom with perforations 0.5 mm. diameter.

Capacity, ml	10	25	35
Current price each	.36	.40	.50
Clearance Sale price each	**.14**	**.16**	**.20**
Stock on hand	1350	115	3200

4137. CRUCIBLE, GOOCH, S. C. P. Porcelain, as above, but with holes 1 mm. diameter.

Capacity 35 ml.	
Current price each	.50
Clearance Sale price each	**.20**
Stock on hand	360

4481. DISHES, S. C. P. Porcelain, round bottom, with spout. Sizes up to and including 120 mm. are glazed inside and outside, while the larger sizes are glazed inside only and for a short distance below the rim on the outside.

Diameter, mm	60	80	85	110	120	145	162	170
Current price each	.21	.26	.30	.57	.66	.80	.90	1.10
Clearance Sale price each	**.08**	**.10**	**.12**	**.22**	**.26**	**.32**	**.36**	**.44**
Stock on hand	1200	1000	630	1300	600	300	650	85
Diameter, mm	185	215	230	265	305	360	400	460
Current price each	1.25	1.66	2.10	3.08	4.85	6.60	15.40	26.40
Clearance Sale price each	**.50**	**.65**	**.80**	**1.20**	**1.90**	**2.60**	**6.15**	**10.50**
Stock on hand	800	385	260	130	52	137	34	91

4484. DISHES, S. C. P. Porcelain, shallow form, flat bottom, with spout, glazed inside and outside except bottom surface.

Diameter, mm	70	80	95	120	160	*160
Current price each	.26	.32	.48	.70	1.14	1.22
Clearance Sale price each	**.10**	**.13**	**.19**	**.28**	**.45**	**.48**
Stock on hand	1000	630	375	57	108	72

* 50 mm. deeper than preceding size.

Above Clearance Sale prices apply only to the quantities specified and are quoted subject to prior sale

ARTHUR H. THOMAS COMPANY

RETAIL—WHOLESALE—EXPORT

LABORATORY APPARATUS AND REAGENTS

WEST WASHINGTON SQUARE PHILADELPHIA, U. S. A.

CABLE ADDRESS "BALANCE," PHILADELPHIA

NOS. 35, 50 AND 65

TROEMNER ANALYTICAL BALANCES

No. 1844

These Balances, designed by and made exclusively for us, are of a rugged and robust construction, which has been found to stand the wear and tear of a works laboratory or of a students' analytical laboratory in a remarkable manner.

Since the first announcement of this series, we have sold over 4000 of these Balances with continued commendation as to their performance and durability, particularly in comparison with many imitations of similar design and appearance.

Our sales have mostly exceeded the production capacity of the manufacturer, but during the next few months we expect to be able to make immediate shipment in all quantities as ordinarily required from stocks on hand.

			Code Word
1840.	**Troemner No. 35 Analytical Balance,** capacity 200 grams in each pan, sensitivity 1/5th mg.; without drawer in baseboard	$50.00	*Aodpo*
1842.	**Troemner No. 50 Analytical Balance,** capacity 200 grams in each pan, sensitivity 1/10th mg	80.00	*Aoehe*
1844.	**Troemner No. 65 Analytical Balance,** identical with No. 50 but with black glass base plate and graduations on both sides of beam	95.00	*Aoeud*

ARTHUR H. THOMAS COMPANY

RETAIL—WHOLESALE—EXPORT

LABORATORY APPARATUS AND REAGENTS

WEST WASHINGTON SQUARE PHILADELPHIA, U. S. A.

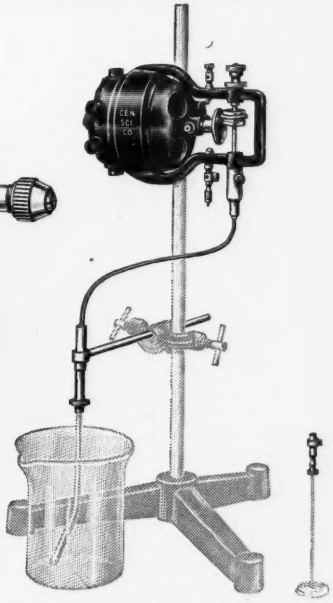
CABLE ADDRESS "BALANCE," PHILADELPHIA

Cenco Built

Universal Laboratory Motor

with Cenco Friction Drive Control

No. 12860



Showing Universal Motor in Use as a Motor Stirrer with Flexible Shaft

12860. **CENCO FRICTION-DRIVE UNIVERSAL LABORATORY MOTOR,** with connecting cord and attachment plug but without support stand, flexible shaft and guide, or stirring rod.

No.	A	B	C	D
	A. C.		D. C.	
For Volts	110	220	110	220
Each	**$35.00**	**$37.00**	**$35.00**	**$37.00**

12861. **FLEXIBLE SHAFT,** 12 inches long, for use with No. 12860, with guide to provide bearing for lower end, and with solid chuck to hold ¼-inch rods..... **$4.00**

For Complete Description Send for Bulletin No. 85-C. E.

CENTRAL SCIENTIFIC COMPANY

LABORATORY Apparatus CENCO Chicago, USA SUPPLIES Chemicals

460 E. Ohio St., Chicago, U.S.A.

Every Teacher of Chemistry in the High Schools and Colleges Should Own a Copy of

The CONDENSED

CHEMICAL DICTIONARY

A handy reference work giving in condensed and readily accessible form essential information regarding chemicals and materials in general use.

This book contains the names and uses of approximately seven thousand chemicals and their synonyms, together with their chemical formulae; colors; properties; constants; specific gravities; melting points; boiling points; solubility in water, alcohol, ether and other solvents; their preparation and materials from which they are made, with a brief outline of the process; their grades, and the kinds of containers in which they are customarily shipped.

It also defines the fire hazards and the railroad shipping regulations pertaining to each chemical.

Arranged and simplified to form a ready reference for those who have need of the particular information it contains.

PRICE

Flexible Leather Binding (with thumb index) $6.00
Library Buckram Binding..... 5.00

BOOK DEPARTMENT

The CHEMICAL CATALOG COMPANY, *Inc.*
21 East 24th Street, New York City, U. S. A.

HEADQUARTERS FOR

LABORATORY APPARATUS
CHEMICAL REAGENTS
DRUGS, MINERALS AND STAINS

Standard Solutions made in our Laboratory; Special Glass Apparatus, according to blue print, in our Glass Blowing Department; Testing Machines of various kinds in our Machine Shop.

Visit us, or write, advising your requirements

Eimer & Amend

Established 1851

NEW YORK, N. Y.
223 Third Avenue

Pittsburgh, Pa., Branch Office: 4048 Franklin Road, N.S.

Kewaunee

Laboratory Furniture for Chemical Laboratories

Because of our line of over five hundred standardized designs, it is seldom necessary to build special equipment if you choose Kewaunee. You will find that we have already met nearly every possible laboratory need with a standard desk, table, bench or sink. Ask for a copy of the Kewaunee Book. Address all inquiries to the factory at Kewaunee.

Kewaunee Mfg. Co.
LABORATORY FURNITURE EXPERTS

C. G. Campbell, Treas. and Gen. Mgr.
166 Lincoln St., Kewaunee, Wis.
New York Office 70 Fifth Avenue
Offices in Principal Cities.

Chemical Laboratory Desk and Hood

11 feet 11 inches long by 2 feet 3 inches wide. Top of birch, body of selected oak. Alberene stone sink.

No. 15025

Chemical Laboratory Desk

A very complete desk of new design. The acme of quality and construction.

No. 15010

POSITIONS WANTED

Under this heading the Journal of Chemical Education will insert individual announcements at the rate of $.03 a word, with a minimum charge of $1.50 for each insertion.

Notices will be inserted in order of their receipt and should be in the hands of the Business Manager at Kodak Park, Rochester, N. Y., not later than the 15th of each month previous to the month of insertion.

The Chemistry Bookshelf

Thirty-four of the foremost authorities have collaborated to present in Bogue's *Theory and Application of Colloidal Behavior* (two volumes, $8.00) a survey of the entire field of colloidal chemistry.

This is without question one of the most important chemical books of 1924.

* * * * *

A new third edition of Mahin's *Quantitative Analysis* ($4.00) is ready. Much new material has been added; two chapters have been entirely rewritten, and the whole book has been brought up to date in matters of general practice and procedure.

* * * * *

Have you looked up the new methods in Reedy's *Elementary Qualitative Analysis* ($1.50)? This book is occasioning a good deal of interest. Only just published, it is already in use in half a dozen representative colleges.

* * * * *

Two more new editions in the *International Chemical Series* are the second edition of Woodman's *Food Analysis* ($3.50) and the fifth edition of Lord and Demorest's *Metallurgical Analysis* ($4.00).

* * * * *

Walker, Lewis and McAdams' *Principles of Chemical Engineering* ($5.00) continues to add to its adoption list.

* * * * *

Have you read in Weiss and Downs' *Technical Organization: Its Development and Organization* ($2.50) the material on Contracts, Patents and Trade Secrets, Publication rights of research chemists, and Cost Accounting and Profit?

* * * * *

The second edition of Norris's *Experimental Organic Chemistry* ($1.50) to correspond with the second edition of Norris's *Principles of Organic Chemistry* ($3.00) is now ready.

Send for copies of these books on approval.

McGraw-Hill Book Co., Inc.
Penn Terminal Building
370 Seventh Avenue New York

EMINENT AMERICAN CHEMISTS
(Second Printing)

Portraits of 33 distinguished American chemists suitable for framing for laboratory, office, den or library, with sketches of the work of each assembled in an attractive loose leaf binder.

An Ideal Gift for a Chemist

Complete set, postpaid, $6.00 with order
Published by the Compiler, D. H. KILLEFFER, 19 East 24th St., New York, N. Y.

Chemistry Teacher Wanted
OR
Position Vacant

Under this heading the Journal of Chemical Education will insert announcements at the rate of $.03 a word, with a minimum charge of $1.50 for each insertion.

Notices will be inserted in order of their receipt and should be in the hands of the Business Manager at Kodak Park, Rochester, N. Y., not later than the 15th of each month previous to the month of insertion.

LIBRARY BOOKBINDING
Magazines, Fiction and Scientific Journals bound at reasonable prices.
MILTON P. HENNEMAN, 309 W. Mulberry Street, Baltimore, Md.